T16D08 – 16.2/3 HL IB Review

Name……

1. The activation energy, of a reaction can be obtained from the rate constant, *k*, and the absolute temperature, *T.* Which graph of these quantities produces a straight line?

A. *k* against *T*

B. *k* against $\frac{1}{T}$

C. ln *k* against *T*

D. ln *k* against $\frac{1}{T}$

2. The mechanism of a reaction is

$XY_2 + XY_2 \rightarrow X_2Y_4$

$X_2Y_4 \rightarrow X_2 + 2Y_2$

$X_2 + Y_2 \rightarrow 2XY$

What is the overall equation for the reaction?

A. $X_2Y_4 \rightarrow 2XY_2$

B. $2XY_2 \rightarrow X_2 + 2Y_2$

C. $2XY_2 \rightarrow 2XY + Y_2$

D. $X_2Y_4 \rightarrow 2XY + Y_2$

3. For the reaction $2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$ the accepted mechanism is

$NO_2(g) + F_2(g) \rightarrow NO_2F(g) + F(g)$ slow

$NO_2(g) + F(g) \rightarrow NO_2F(g)$ fast

What is the rate expression for this reaction?

A. rate = $k[NO_2]^2[F_2]$

B. rate = $k[NO_2][F_2]$

C. rate = $k[NO_2][F]$

D. rate = $k[NO_2]^2$

4. (a) The variation of the rate constant, *k*, for a reaction with temperature is shown by the Arrhenius equation. Two versions of this equation are shown in Table 1 of the Data Booklet.

(i) Explain the significance of the Arrhenius constant, *A*, in this equation.

(1)

(ii) Explain what is meant by the term *activation energy,* E_a.

(1)

(iii) Describe how, using a graphical method, values of *A* and E_a can be obtained for a reaction.

(5)

(b) The equation for a reaction used in industry is

$CH_2CH_2 + Cl_2 \rightarrow CH_2ClCH_2CL \qquad \Delta H^{\ominus} = -185$ kJ

Iron(III) chloride can be used as a catalyst for the reaction.

(i) Explain the difference between the terms *homogeneous* and *heterogeneous* when applied to a catalyst.

(1)

(ii) Draw an enthalpy level diagram for this reaction, including labels for $\Delta H^{\ominus}$, E_a and the activation energy when a catalyst is used, E_{cat}.

(4)
(Total 12 marks)

5. Nitrogen(II) oxide reacts with hydrogen according to the following equation:

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

The table shows how the rate of reaction varies as the concentrations of the reactants are changed.

Experiment	Initial [NO] / mol dm^{-3}	Initial [H_2] / mol dm^{-3}	Initial rate / mol (N_2) dm^{-3} s^{-1}
1	0.100	0.100	253×10^{-6}
2	0.100	0.200	5.05×10^{-6}
3	0.200	0.100	1.01×10^{-5}
4	0.300	0.100	2.28×10^{-5}

(a) Determine the order of reaction with respect to H_2 and with respect to NO.

H_2 .....

NO .....

(2)

(b) Write the rate expression for the reaction.

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(1)

(c) Calculate the value for the rate constant, and state its units using the data from experiment 1.

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(2)

(d) A suggested mechanism for this reaction is as follows.

$H_2 + NO \rightleftharpoons X$ fast step

$X + NO \rightarrow Y + H_2O$ slow step

$Y + H_2 \rightarrow N_2 + H_2O$ fast step

State and explain whether this mechanism agrees with the experimental rate expression in (b).

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(4)

(e) Explain why a single step mechanism is unlikely for a reaction of this kind.

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(2)

(f) Deduce and explain how the initial rate of formation of H_2O compares with that of N_2.

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(2) **(Total 13 marks)**